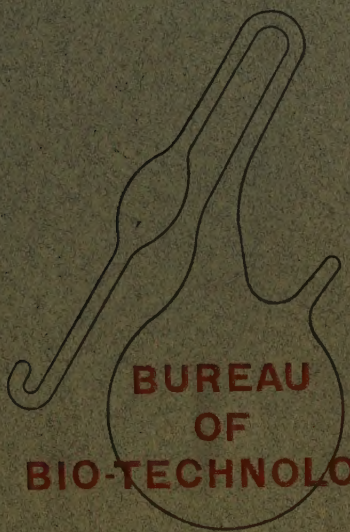
BULLETIN No. 5

MARCH, 1922



IMPERIAL BUREAU
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OF MYCOLOGY

CONTRIBUTIONS FROM THE BIOLOGICAL, CHEMICAL AND PHYSICAL RESEARCH :: LABORATORIES OF ::

MURPHY & SON, LTD.

LONDON, LEEDS AND NOTTINGHAM

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FOREWORD

THIS is the first occasion on which we have had to complain of "pressure on our space." As a consequence of the influx of papers from members of our Departmental Staffs we are reluctantly obliged to hold over our third instalment of "Micro-Organisms in the Leather Industries" for inclusion in our next issue.

We have been gratified by the response of subscribers to the *Bulletin* at the rate of 7/6 per annum, and we shall be glad to hear from those readers who have not yet expressed their wishes in this matter.

MURPHY & SON, LTD.

March, 1922.

A Rapid Method

for the

Estimation of Acetaldehyde

IN the course of some work on butyric acid, it was observed that this substance gave an intense yellow colour when mixed with a solution of benzidine hydrochloride. The reaction was investigated with a view to devising a colorimetric test for butyric acid, since negative results were obtained with pure formic, acetic and lactic acids. Formaldehyde and acetaldehyde, however, produced intense yellow or brown colours. " Pure " butyric acid was fractionated and the fraction boiling between 162° and 163° tested. It gave a strong colour with benzidine, but no aldehyde reaction. It was next purified through the silver salt, and it was found that the acid thus obtained gave a much paler colour than the original acid. Another sample of " pure " butyric acid was therefore obtained and fractionated. The fraction boiling at 162° – 3°C. had a specific gravity of 0·9609 at 20°, and was presumably free from isobutyric acid. It gave no colour with the benzidine reagent, the colour originally obtained being apparently due to some high-boiling, non-aldehydic impurity.

The benzidine reaction with aldehydes was next investigated. The reagent was prepared as described by Treadwell (*Analytical Chemistry*, 1919, Vol. II., 715) and the standard acetaldehyde

solution by the method of Rocques (*Ann. Chim. anal. appl.*, Vol. 3, 365). The slight colour of the benzidine hydrochloride solution was removed by treatment with decolorizing carbon for a short time, on the water-bath. The procedure consisted merely in mixing 5 c.c. of the aldehyde solution with an equal volume of the reagent, and observing the intensity of colour after a fixed interval of time. The colour obtained with both aldehydes is yellow, increasing in intensity with time, and finally becoming brown or orange. In the case of formaldehyde the colour develops somewhat slowly, a 0·1% solution just giving a reaction after some hours' standing; an acetaldehyde solution of equal concentration gives a noticeable colour in 10 minutes. A 1% solution gives a strong yellow colour immediately.

In using the method a preliminary test is first made to ascertain the approximate amount of aldehyde in the solution. The latter is then diluted, if necessary, to bring the concentration within the limits of 5% and 0·1%. To 5 c.c. of the diluted solution 5 c.c. of the reagent are then added, the same amount being added to a series of standard aldehyde tubes at the same time. The colours are compared after 30 minutes.

Rocques' standard acetaldehyde solution can be kept for some time, but it has been found advisable to prepare a stock of pure acetaldehyde-ammonia, and to use this for making up standard solutions at intervals.

The benzidine method is not sufficiently sensitive to be used for the estimation of very small amounts of acetaldehyde, but it has been successfully applied to the rapid determination of this aldehyde in moderate concentrations.

N. K. Smitt.

A Book on Yeasts

A REVIEW FROM THE LABORATORY

A LOOSE-LEAF Index to the Yeasts in which all the spore-forming species were placed under a main heading entitled "Non-sporulating Yeasts," suggested the necessity for these notes. The Index was found in the hands of a beginner in the study of Yeasts, and upon presuming to question the accuracy of such an arrangement, the writer was referred to the latest authoritative book on the subject, viz.:

> "The Yeasts, by Alexandre Guilliermond, D.Sc., Professor of Botany, University of Lyon. Translated and thoroughly revised in collaboration with the original author by Fred Wilbur Tanner, M.S., Ph.D., Assistant Professor in Bacteriology, University of Illinois. (New York, 1920)."

An inspection of this book showed that the Index in question had been accurately copied from the "Table of Contents." On p. xii., the contents of Chap. X., under the heading, "Family of Non-Saccharomycetes," includes all the groups, genera and species of organisms that must be regarded as true *Saccharomycetes*. Chap. XI. is headed "Family of Non-Saccharomycetes or Doubtful Yeasts," and this properly includes the species of *Torula*, *Mycoderma* and other non-sporulating yeast-like organisms. To one with any knowledge of the subject it is at once evident that an error has been introduced, but to a student who comes fresh to the study of the Yeasts, and for whom, apparently, the book is intended, it is not so obvious. If this were the only error of its kind it could

be adjusted without further qualms on the part of the reader, but a consideration of the text does not readily restore the faith that must be inspired by a book before it can be successfully used as a Text-Book.

On page 1, of the Introduction, the following paragraph occurs :

> " The basidiospores of certain *Basidiomycetes* (*Calcera viscosa*) and ascospores of certain *Ascomycetes* (*Sphærulina intermixta Taphria*) give rise to yeasts, and it is only after living for a certain time in this form that the yeast cells elongate filaments and produce a mycelium."

The first name in brackets is incorrect, and should read *Calocera viscosa*. The names contained within the second set of brackets are intelligible only to one who already possesses a good knowledge of the fungi ; in addition to perpetuating an error made by Guilliermond in the original, published eight years earlier, further confusion is introduced by the omission of a comma—it should read : " (*Sphærulina intermixta, Taphrina*)."

On the same page is a paragraph reading as follows :

> " The Mucors, when placed in sugar solutions, are able to dissociate their filaments into round bodies, or buds, in a similar manner as the yeasts."

This is capable of misinterpretation by the student.

On p. 2 the reader is introduced to the term " ascs," meaning asci. This, and " asc " for ascus, are employed throughout the book. The use of these words is a departure from recognised mycological terminology that should be discouraged among students.

The same observation applies to the spelling of " clamydospore " for " chlamydospore " on p. 13 ; " Phanerogames " for " Phanerogams," p. 40, and the use of " scum " for " film " throughout the book.

A combination of mis-statement and ambiguity, which is one of the more serious defects of the book, is illustrated by a paragraph on p. 3, and in order that no misconstruction may be placed upon

statements of the authors by omission of context, it is quoted in its entirety :

> " *True yeasts never produce endo- or ascospores.* Do they represent forms derived from more highly developed fungi and made constant by a long adaptation to this condition ? Or, are they true Saccharomycetes having lost, by a series of unknown circumstances, their aptitude of forming spores ? We shall see that a definite loss of this characteristic has often been proved among the Saccharomycetes during special conditions. Be that as it may, the origin of the yeasts is entirely ignored ; the Saccharomycetes are then separated and regarded as yeasts of uncertain origin. In this book we shall examine extendedly only the true yeasts : first, yeasts with ascospores, or Saccharomycetes ; secondly, those cells which exhibit all the characteristics of Saccharomycetes with the exception of ascospore formation and which, from the above, one might call psuedo-yeasts. All of those yeast-like structures of other fungi will be neglected. True yeasts are very abundant in nature ; over five hundred are known. The limits of our study must be rather wide."

The first sentence, italicised by the present writer, constitutes a definition contrary to that accepted by other workers in microbiology. It would require too much space to point out all the imperfections in that paragraph, and one would like to know what a student is expected to learn from it.

Before any progress can be made in the study of Yeasts, it is essential to obtain a thorough grasp of the principles of classification. It is at least necessary for a student to know exactly what is meant by the recognised terms order and genus, and to understand and appreciate the significance to be attached to the use of such names as *Saccharomycetaceæ* (sometimes called *Saccharomycetes*) and *Saccharomyces*. This, in practice, is difficult for one who comes to this subject with no knowledge of systematic botany (or zoology), and the greatest care should be exercised by a teacher in the use of such names and terms. This point does not appear to be appreciated by the authors. On p. 6, in a discussion of the forms of cells, etc., they say :

> " Often, a red pigment may be observed, sometimes a brown, gray or yellow one ; in this case it is probably not a true *Saccharomyces*, but a yeast without endospores."

A yeast without endospores—or, more accurately, ascospores—would be excluded not merely from *Saccharomyces*, but also from the *Saccharomycetaceæ*, a fact of special importance to the student at this stage of his progress.

The climax of this confusion of Order and genus is reached on p. 190, in connection with the classification of yeasts, and here, again, it will be necessary to reproduce the paragraph as it stands :

> " In the family of *Saccharomyces*, we shall include all yeasts which sporulate whatever their mode of division. Contrary to Hansen, we shall not separate the *Schizosaccharomyces*. These yeasts, if they are differentiable from the other yeasts by the mode of division (transverse partition), belong incontestably to the *Saccharomycetes* by the copulation which preceded the formation of the asc with the greater part of them. They are related to the *Saccharomycodes* in which the cells divide by an intermediate method between typical partition and budding and which offer a form of transition between the *Schizosaccharomyces* and other yeasts. We shall subdivide the *Saccharomyces* into five groups."

Now, no organism that vegetates by any method other than that of budding (as distinct from reproduction by sporulation) can possibly be placed in the genus *Saccharomyces*, and the name of the Order, *Saccharomycetaceæ*, or the *Saccharomycetes*, should be substituted. In the middle portion of the paragraph " *Saccharomycetes* " is correctly used, but in the last sentence "*Saccharomyces*" is again introduced erroneously. In the latter case, confusion is further complicated by the statement that " the *Saccharomyces* are sub-divided into five groups," whereas, on p. 231, they are actually sub-divided into six groups, and it is the *Saccharomycetaçeæ* that are sub-divided into five groups, of which, *Saccharomyces* is one and *Schizosaccharomyces* another.

In a discussion of the nucleus, in the chapter on the " Cytology of Yeasts," p. 37, the authors say :

> " This conception was specified by Wagner in 1898 and again by Wagner and Penistone. These authors described in the yeasts, first, a vacuole, *vacuole nucleare*, filled with chromatin particles, and, secondly, a nucleole of homogenous appearance, situated at the exterior of this vacuole but always close to it."

" Wagner " is repeated three times more on the same page, twice on the following page, and again on p. 39.

Students not familiar with the literature of this aspect of the subject can hardly be expected to know that the name of the British cytologist, H. Wager, should be substituted for " Wagner " in each case. Those already acquainted with the subject will be able to appraise the rest of the paragraph, and the remaining part of the chapter, at their proper value.

At times it is difficult to gather who is responsible for the cytological work upon which statements are made and theories advanced. Sometimes reference is made to Guilliermond, as, for instance, in a paragraph on p. 37, which commences :

> " Guilliermond has given this debated question of yeast structure much study since 1901,"

and which closes thus :

> " The existence of nucleus cannot be doubted. The presence of it is now admitted."

At other times it would appear that researches on this subject are the joint work of the authors. With reference to " metachromatic corpuscles," they say, p. 40 :

> " We have shown that they are identical with other bodies which have been observed formerly in the bacteria and *Cyanophyceæ* by Babes and Bütschli, and regarded as grains of chromatin."

In cases where the views of other workers are not in agreement with their own, the authors adopt a very perfunctory method of dismissal. This may be instanced in a reference to the work of " Wagner," p. 37, and to that of Klöcker and Dombrowski, p. 369. On p. 42, with regard to suggestions that have been made as to the possibility of a relationship between pathogenicity and the granular contents of bacterial cells, they say :

> " This theory was supported by Behring, who *pretended* to have extracted the metachromatin from *Bacterium tuberculosis* and stated that this substance corresponded to the toxin of that bacterium."

The word " pretended " has been italicised by the present writer.

In the chapter headed "Symbiosis of Yeasts, p. 124, it is stated with reference to a case reported by Will, in which two varieties of yeast had "functioned" in a brewery for twelve years without change in their individual characteristics, that:

> "A sort of equilibrium seems to have been established between the two varieties which permits them to live together without harming each other. Schönfeld has cited a similar case of a little brewery in which the leaven for four years gave a rapid clarification with feeble alternation. This leaven was composed of two yeasts, one which had low alternation, and the other with a higher alternation."

Without questioning the docility which permitted Will's two organisms "to live together without harming each other," it may be pointed out that the first part of the paragraph does not furnish an illustration of symbiosis, as generally understood. The use of the term "leaven" in connection with brewing is unexpected in a modern book on Yeasts; and how do the authors justify the repeated occurrence of the word "alternation"? Certainly neither Will nor Schönfeld wrote anything of the kind, and the writer has already found it necessary to explain to two bewildered readers that the substitution of the term "attenuation" for "alternation" will alone make this paragraph intelligible.

One of the few lines dealing with the relationship of yeasts to bread-making is found in this Section, and it reads thus:

> "The fermentation in bread seems to result by the symbiotic action of a yeast and bacteria."

Students requiring further information on this point are left to seek it elsewhere.

A chapter on Symbiosis is singularly incomplete without any reference to the ginger-beer plant of Marshall Ward, and the organisms composing it. On page 109, in another connection, the yeast symbiont is mentioned as *S. Pyriformis*; on p. 247, in the systematic part of the book, this yeast is called *Saccharomyces Piriformis*, and it is there explained that

> "It grows in symbiosis with *Bacterium vermiforme* and is found in the sheath of this organism."

One might reasonably expect some amplification of this statement.

With regard to symbiosis between two totally different organisms, "such as a yeast and an animal," the authors say, p. 126:

> "Thus, Lindner found *Saccharomyces apiculatus parasiticus* in an hemoptera, *Aspidiotus Nerii*;"

and on p. 324,

> "Lindner discovered this yeast in 1895 in the body of an Homoptera *Aspidiotus Nerii*."

Before endeavouring to assimilate this information, the student should obtain the criticism of a competent entomologist.

One is unable, in many instances, to reconcile the English revision with the French original, and a note on the biology of the last-mentioned yeast is a typical instance. In the French original, p. 398, the following occurs:

> "Le *S. apiculatus parasiticus* se transmet par les œufs et pénètre ensuite dans les différentes cellules de la larve en perforant leurs parois par ses extrémités pointues."

This on revision becomes

> "*Saccharomyces apiculatus parasiticus* is transmitted by the eggs and finally enters the larvæ to penetrate their uttermost extremities."

Alternative spellings of the names of both authors and organisms are frequent. One of the more subtle examples may be quoted. Reference is made, on p. 20, to a small fly which is there called *Drosophilia funebris*. On p. 292 it is written *Drosophila funebris*, while on p. 384 the generic name is again varied, and it appears as *Drosophilus funebris*. Non-entomological readers are hereby informed that *Drosophila* is the correct generic name.

Many serious errors occur in the chapter on "Methods of Culture and Isolation of Yeasts." Formulæ given for the preparation of media have been incorrectly copied from the originals. In Hansen's No. 1 Medium, "Maltose" has been substituted for "Dextrose." In the case of Mdle. Gorodkowa's medium for yeast sporulation, the pabulum made up according to the formula given would not bear a remote resemblance to the original. By translating

into English the French *gélose* as gelatine, and by omitting peptone altogether, the authors have revolutionised its composition and have given a formula for a solid medium that will not set !

On p. 173 the student is given the following information :

> " Plate culture : This is prepared by putting a little of the yeast in dilution into a Petri dish. The dish is partially filled with gelatine which serves as a food."

No more insidiously misleading information than that contained in this paragraph could be offered to a student of the yeasts.

It would be impossible in the space at disposal to point to all the weaknesses in the portions of the book dealing with the " Physiology of Yeasts." Two or three illustrations will indicate the nature of some of these.

The only reference to Hydrogen Ion Concentration consists of three lines : it is found in one of two paragraphs under the heading "Antiseptics" ! This is how it reads :

> " Euler and Emberg have stated that the hydrogen centration influences the development of bottom yeast. This is to be expected, since other forms of micro-organisms act in the same way."

Shades of Sørensen and Emslander ! If we can trust the English of the above paragraph it would appear that " hydrogen centration " is a form of micro-organism !

The first of the two paragraphs mentioned as coming within the scope of "Antiseptics," contains a reference to certain substances employed by Lindner and Grouven, viz :

> " Corrosive sublimate (ammonia), fluoride."

Also the following statement :

> " Will and Wieninger experimented with ozone on yeast. They found that 0·56 gram. in a cubic centimetre of air was toxic for 30,000,000 cells."

0·56 gram. of ozone in 1 c.c of air would be a pretty stiff atmosphere, in more than one sense, but the proportion really reported by Will and Wieninger was " 0·56 gram. of ozone per cubic metre."

It is fortunate, perhaps, that the subject of "Antiseptics" is dismissed in eleven lines.

Many of the slips in the chemistry of the book may be rectified by a student with an elementary knowledge of chemistry, as, for instance, the formula given for a certain "uncommon salt," p. 110 :

> "Bokorny studied the effect of certain uncommon salts. RB_2SO_4 and Cs_2SO_4,"

although, a beginner may be pardoned for not recognising Rubidium sulphate from the formula used in the text. In the several pages on "Hydrocarbon Compounds," and in such phrases as "The Hydrocarbon Metabolism of Yeasts" (p. 75), he will note from the substances named that "Carbohydrate" should be substituted for "Hydrocarbon."

In some cases, however, the error is not so transparent, as the following illustration will indicate. In a discussion of the theories of fermentation, "Lebedeff" is mentioned twice on p. 97 and "Lebedew" twice on p. 98; a series of equations said to represent the changes that take place in alcoholic fermentation, according to the worker under the former name, p. 97, is completed as follows :

$$C_6H_{10}O_4\,(RPO_4)_2 + H_2O = C_2H_5OH + CO_2 + C_3H_6O_2 + 2\,(RHPO_4)$$

On careful inspection it will be seen that this is not an equation.

The book also contains an unusual number of printers' errors and mis-spelt names. One reviewer has charitably described the latter as "blemishes"; if space permitted it could be shown how such blemishes react unfavourably on the outlook of a student who has no guidance other than that of a carelessly-written book. The study of the Yeasts is so important a branch of Bio-Technology that too much stress cannot be laid upon the necessity for accuracy in every detail, and in the interests of Micro-biological science this book on "The Yeasts" calls for further revision.

F. A. M.

The Isolation of Bacteria from Beer Deposits

DURING recent work upon the bacterial flora of beers under incubation the need for a medium which will produce a maximum bacterial count has presented itself. The routine beer-agar and wort-agar under ordinary conditions are inadequate, and in our experience the isolation of the bacteria observed in a given sample is exceedingly difficult, if not impossible, by the use of the above media. Whilst there is a small number of species of bacteria in beers which develop fairly rapidly upon wort-agar, there are undoubtedly many others which grow feebly upon it, or, having grown, frequently die. The two difficulties presenting themselves to the writer have been, firstly, the failure to obtain a representative growth of bacteria upon the media hitherto employed; secondly, the similarity of the colonies of yeast and those bacteria which have grown. These two points have been borne in mind throughout the endeavour to construct a convenient routine medium for laboratory control work.

It would be difficult to prepare a medium which would eliminate the yeasts whilst still offering suitable conditions to the bacteria, but a medium equally suitable to both would serve our purpose and would convey a better idea of the relative flora.

Preliminary trials with wort-agar adjusted to different hydrogen ion concentrations gave little encouragement for further procedure in this direction. The medium was employed at pH 8, pH 6, pH 5·2, and pH 3·5 respectively. Petri-dish cultures of a beer deposit upon these four media, whilst showing marked differences

in the yeast growth, offered no increased facilities for the isolation of the bacteria. There was not the inhibition of yeast growth at pH 3·5 that one would have expected, and, although the yeast colonies remained quite small, they were still profuse over the surface of the plate, which rendered sub-culturing difficult. The growth of yeasts as intensely aerobic surface cultures probably results in the complete oxidation of the sugars into carbon dioxide and water. This would account for the acidity developed by plate cultures from beers, in view of which the observer should not assume the presence of bacteria of the Acetobacter type without confirmation.

For purposes of any bacteriological survey a medium is required which will reproduce as nearly as possible the conditions obtaining in the material from which the bacteria are to be isolated.

The conditions prevailing in bottled beers may be broadly described for our purpose as follows :—

> The bacteria are growing under almost anaerobic conditions—*i.e.*, in presence of carbon dioxide :
>
> The materials available for metabolism may be :—Proteins, unfermented carbohydrates, and fermentation products from the original wort.
>
> There are present living primary and secondary yeast cells, and also the dissociation products of the dead yeast cells.

The bacteria which develop in such an environment are those we wish to study in connection with the keeping qualities of beers. The employment of wort-agar under aerobic conditions does not seem to fulfil these requirements, and, as one example, organisms of the Lactobacillus type could not be expected to grow.

The medium to be described, used in an atmosphere of CO_2, appears to have introduced the necessary elements. The metabolic products of a normal fermentation, together with unfermented carbohydrates, were obtained by including in the medium a partially fermented hopped wort. The dissociation products of the yeast cells were obtained in the form of yeast " autolysate," that is, yeast which had been placed under conditions favourable to autolysis. It has been shown that many cells produce autolysins,

that is, enzymes bringing about self-digestion, and yeast cells are not an exception. Certainly, in the beer, digestion products of the yeast cells are present, and, as one might expect, the use of dried yeast does not fulfil the purpose of the autolysate. The adoption of yeast autolysate as a bacterial nutrient is not new, it has been employed by Kliger (1917) and others as a substitute for beef extract. However, its adoption is particularly appropriate in this case.

The technique of the preparation of the suggested medium is as follows :—

> 100 grams of yeast are shaken with 500 c.c. of water and a few drops of toluene or chloroform added. This is kept in the incubator for about 48 hours to allow time for autolysis to take place, and the clear solution is then poured off.
>
> 500 c.c. of wort are inoculated with yeast and fermentation is allowed to progress for 24 to 36 hours.
>
> The two solutions are now mixed, 1·5 per cent. of agar is added, and the whole subsequently steamed and filtered.
>
> The pH of this medium is usually about 4·5, and it may either be used at that acidity or adjusted to pH 4, when it will be found to produce smaller yeast colonies.
>
> The addition, under aseptic conditions, of small amounts of alcohol to the melted medium immediately before pouring into the plates is recommended.

Surface inoculations upon this medium in Petri dishes were made and incubation carried on in an atmosphere of carbon dioxide. In order to do this the plate cultures were placed in a vacuum desiccator containing carbonate and acid.

Comparisons of results obtained by other media and by the one described have led us to adopt the latter for routine work. For fuller bacterial investigations simultaneous cultures upon MacConkey's medium, and whey- or milk-powder-agar, as well as upon the above, give useful results.

Of 15 bacterial cultures from beers all but two failed to grow upon beef agar ; the difference in growth upon wort-agar and upon the yeast medium was obviously in favour of the latter. Two of

these cultures upon wort-agar subsequently died whilst this did not occur upon the yeast medium.

The incubation in carbon dioxide has been accompanied by aerobic controls, and it is found that a repression of yeast growth in the former assists the operation of sub-culturing the bacteria. For the retention of pure cultures the aerobic slope tube is usually effective.

The similarity between the bacterial and yeast colonies renders examination of the plates somewhat tedious. To meet this difficulty trials have been made with indicators, particularly those of Clark and Lubs, incorporated with the yeast medium. So far no specific difference in ultimate pH of either the bacterial colonies or those of the yeasts has been demonstrated, which might be made use of as a means of differentiation, although the results obtained have prompted us to proceed further along these lines. The sugar reactions of strains of bacteria already isolated do not point to any one sugar fermented by the bacteria and not by the yeasts, which might be utilised in conjunction with an indicator in the preparation of a differentiating medium.

P. Hampshire.

Trogoderma khapra

MEMORANDUM ISSUED BY THE MINISTRY OF AGRICULTURE AND FISHERIES.

As the result of finding the wide-spread occurrence of *T. khapra* in British maltings (as already reported in the pages of the *Bulletin*), representations with regard to the urgency of a need for control measures were made to the Ministry of Agriculture. At the request of the Ministry a Report embodying suggestions was drawn up by our staff for submission to the Entomologist of the Ministry, and a Memorandum based on this Report has now been issued. We are indebted to Sir Daniel Hall for a copy of same, which reads as follows :—

" *Trogoderma khapra* is a beetle which does much harm to stored wheat in India. It is commonly imported into England with Indian wheat. When the Grain Pests Committee of the Royal Society started work in 1916 the pest was noted in most Indian consignments, but there appears to be little known as to its previous introduction ; this is doubtless due to the absence of any entomological examination of imported wheat. As regards the potential danger to be anticipated from its introduction, four points of view must be considered, of which the first is of chief importance to the Ministry :—

(a) *Home-grown Wheat.*—The beetle is essentially an insect of hot dry climates. It is stated to cease activity at the temperature of the Punjab winter, and to flourish best at the temperature of the Punjab summer. It is therefore most unlikely that the climate of the British Isles would be favourable to the pest, and this view is entirely supported by my own experience of the insect. Both from this point of view, and also because threshed English wheat

is not kept in storage for more than a few weeks, little danger, in my opinion, need be apprehended.

(b) *Imported Wheat.*—If it became a settled policy to store large reserves of imported wheat in the British Isles, the possible effects of this and other grain pests would clearly have to be considered. It is understood that lengthy storage was not the pre-War practice, and for short periods the beetle is not likely to do serious damage. Further, the impression was gathered, in the course of the investigations of the Committee previously mentioned, that *T. khapra* would breed but slowly, if at all, at the temperatures at which imported wheat is usually stored. Under the circumstances, it should prove of less importance than the better-known grain weevils, and would not merit separate measures to combat its introduction.

(c) *Grain Products.*—Where, as in the case of malt, a high temperature is maintained in process of manufacture, the insect might prove very troublesome. Nevertheless, it is doubtful whether general measures directed against Indian wheat could be justified on account of possible danger to manufactured grain products. The discovery of suitable control measures would seem the more economic procedure.

(d) *Exports.*—It is true that countries attempting to keep out *T. khapra* might legislate against the exports of a country which took no such action. In this connection it must be remembered : (i) that Britain is *not* a grain-exporting country ; (ii) that the U.S.A., the most likely country to legislate against our imports, has already gone to extreme measures, and it is very doubtful if, on the grounds of *T. khapra*, any further restrictions could be imposed.

On all grounds, therefore, it would seem that the Ministry is not called on to take action with regard to *T. khapra*. This opinion must not be taken as minimising the importance of the pest from the Imperial standpoint, an entirely different matter which is worthy of the most careful consideration. In this connection, attention is drawn to the proposals outlined in Memorandum 5 of the Grain Pests Committee of the Royal Society, (March, 1919).

A Note on Soil Sterilisation for Tomatoes*

IT is now an established fact that the plant is dependent to a greater or less extent upon the presence of certain micro-organisms in the soil, in order that it may carry out its natural functions ; the reverse is also true that some of the organisms are dependent upon the plant.

To use the words of Dr. Russell, " there is a certain amount of mutual interdependence between the various members of the flora and fauna, but also some antagonism."

In soil sterilisation processes on a large scale, it is therefore necessary to determine the exact conditions whereby the malignant organisms are destroyed, leaving the benignant to carry on their essential work.

Fortunately the harmful bacteria tend to be killed before those which are beneficial to plant life, hence the sorting out of the soil population greatly assists the soil fertility.

In " sick " soils, or those where disease-producing organisms are to be found, some of the soil bacteria may seriously affect the life and general growth of the plant. It is in such cases that the best effects of partial sterilisation of the soil may be noted.

The following work has been carried out to test the suitability of certain substances for partial sterilisation and at the same time to observe what effects, either beneficial or otherwise, may be derived from such treatment upon the plant and its crop.

---

* Contributed from the Agricultural Testing Station of Messrs. Murphy and Son, Ltd., and issued by the Technical Committee of the Chamber of Horticulture.

It should be stated that no preliminary examination of the soil population was made.

Methods Used.

A small house was sub-divided into equal plots, each of about 11½ sq. ft. superficial area ; the soil being a poor loam.

Slaked lime at the rate of 1 lb. per plot was applied and dug in on May 10th, 1921.

The soil was treated two days later with the preparations indicated and in the following manner :—

Plot 1.—Reserved as control and received no further soil treatment except manures.

Plot 2.—Half a gallon of an aqueous solution of dichlorcresol 0·1 per cent. and cresol (or cresylic acid) 0·4 per cent. emulsified with soap, watered in ; the final solution was neutral in reaction.

Plot 3.—Four oz. of a mixture of 7½ per cent. dichlorcresol absorbed in 92½ per cent. of 18-20 basic slag. Spread broadcast and watered in with approximately one gallon of water.

Plot 4.—Half a gallon of an aqueous solution of 0·1 per cent. p-Toluene sodium sulpho-chloramide, watered in (a very powerful, yet easily decomposed, disinfectant).

Plot 5.—Half a gallon of an aqueous solution of 0·5 per cent. cresylic acid emulsified with soap, watered in ; the final solution was neutral in reaction.

After a week had elapsed nine tomato plants were put into each plot, forming two rows, the five in the rear being Sutton's " Best of All," raised from seed, and the four in front being " Kondine Red " plants which had been bought in.

All the plants showed excellent condition and were of an average height of 9 in.

A month after planting each plot received a surface dressing of two-thirds of an oz. of a mixture of 2 parts superphosphate and 1 part kainit, and during the first week in July all the plants were sprayed with ammonium copper carbonate solution containing 8 oz. of copper carbonate per gallon used at 1 gallon to 100 gallons of water.

This was applied purely as a preventive measure against Cladosporium fulvum.

Observations on Growth of Plants.

For about a fortnight to three weeks after planting all showed approximately the same amount of healthy growth. Then in plot 4 the plants began to fall behind, and apparently remained stationary in growth for about three weeks. At the same time the plants in plots 2 and 3 began to show greater and much more vigorous growth than the control or plot 5.

At the end of six weeks plot 5 seemed to show a considerable improvement, but it certainly did not compare with any of the plants in plots 1, 2 and 3.

By August 1st an appreciable falling off in vitality was observed in plots 4 and 5, and from that date onwards the haulm began to wither gradually.

The foliage and haulm in plots 2 and 3 was much darker in colour than any of the others, and in plot 3 it was distinctly sturdier.

The ripened fruit was picked on July 29th and subsequently on every 3rd or 4th day.

On September 22nd all the remaining fruit on the various plots was gathered and the following observations were made on the general state of the plants :—

Plot 1.—Control—Plants still vigorous and healthy, plenty of green foliage with stout haulm.

Plot 2.—Plants fairly vigorous, fair amount of dark green foliage with excellent haulm.

Plot 3.—Plants showed signs of withering. Fair amount of dark green foliage left with very stout haulm.

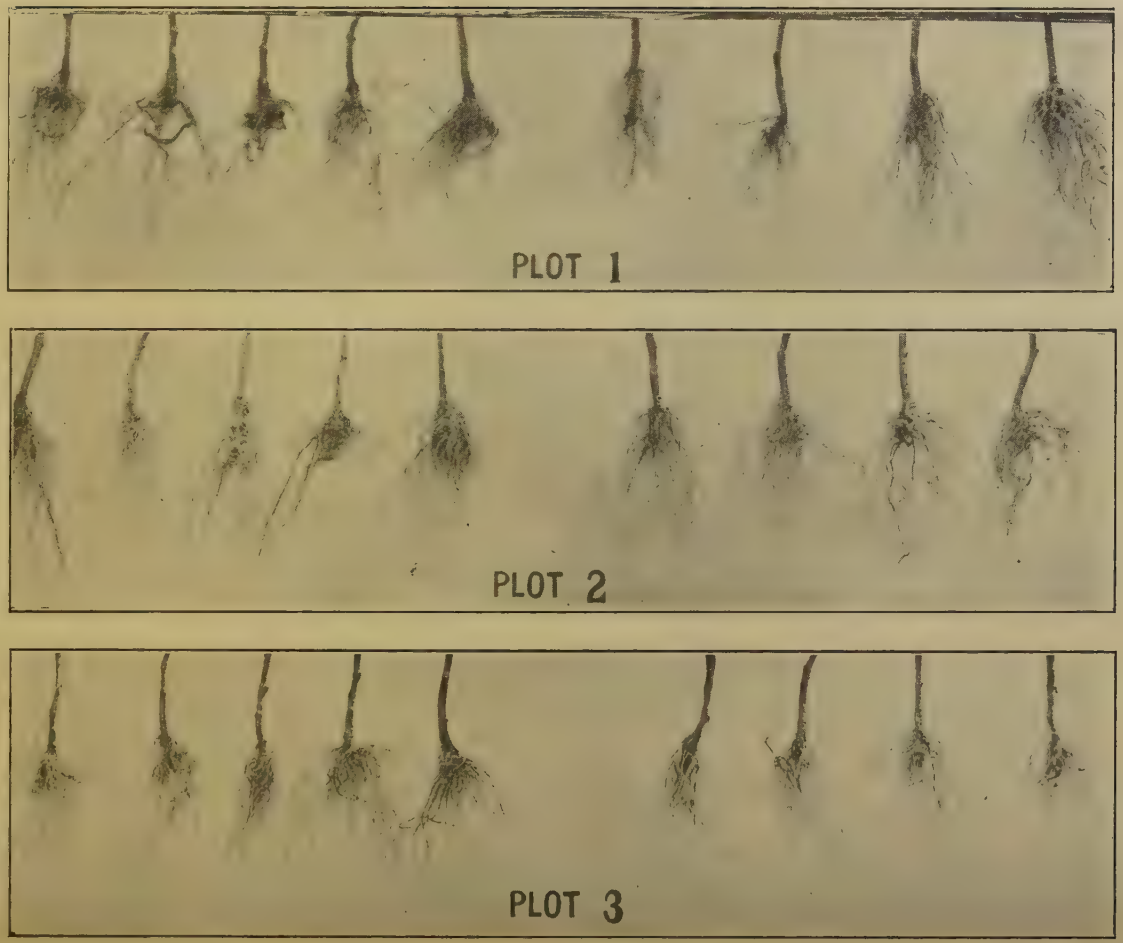
Plot 4.—Foliage withering; fair amount of pale green foliage; haulm very weak.

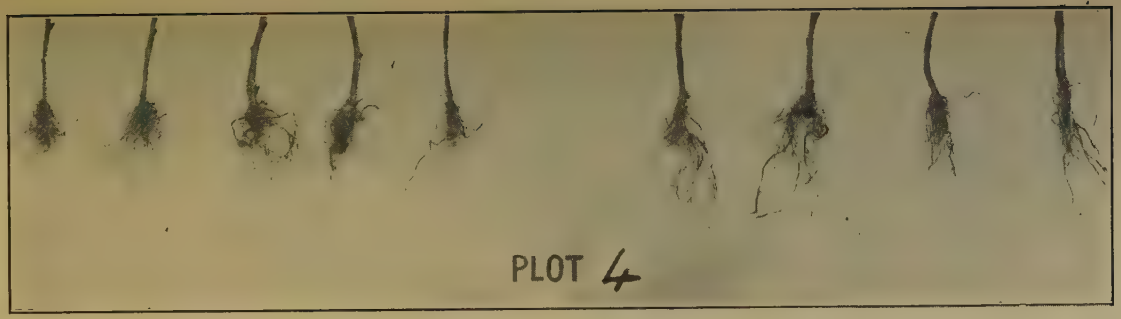
Plot 5.—Majority of plants practically dead and others dying off. Very little foliage left. Most of the haulm weak.

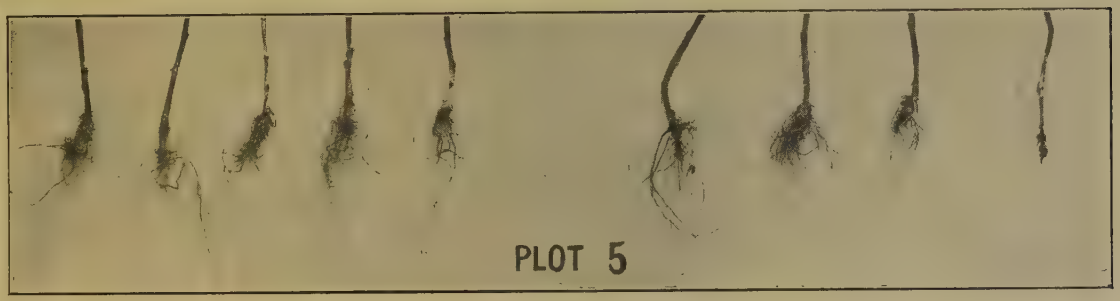
No Cladosporium was noticed in any of the plots. The crops for the various plots were as follows :—

Plot.	Total Crop.	Aver. Crop per Plant.
1	369 oz.	41·0 oz.
2	293 oz.	32·5 oz.
3	332 oz.	36·9 oz.
4	209 oz.	23·2 oz.
5	167 oz.	18·5 oz.

SUTTON'S "BEST OF ALL." "KONDINE RED."







Plot 1	...	Control, 23 lb. 1 oz.
Plot 2	...	Dichlorcresol and Cresol Mixture, 18 lb. 5 oz.
Plot 3	...	Dichlorcresol and Basic Slag, 20 lb. 12 oz.
Plot 4	...	p-Toluene Sodium Sulpho-chloramide, 13 lb. 1 oz.
Plot 5	...	Cresol (Emulsified), 10 lb. 7 oz.

SOIL STERILISATION OF TOMATOES.

All the plants were dug up and any adhering soil shaken off, great care being exercised to prevent any damage to the root fibres.

The roots from each plot were then photographed, the following points being noted :—

Plot 1.—Roots showed cankerous growths, together with nodules similar to those produced by eelworm.

Plot 2.—The root growth and fibres were greater than in the control plot, and showed no sign of cankerous growths or nodules. Very healthy-looking and the fibres uniformly distributed.

Plot 3.—Very similar to plot 2.

Plot 4.—The roots were very stunted, but apparently healthy, showing no sign of canker or nodule.

Plot 5.—More stunted than No. 4, but apparently healthy.

Conclusions.

The experiments undoubtedly bring out the fact that soil sterilisation must not be carried out in a haphazard or "rule of thumb" manner. They also show that a previous knowledge of the soil population is vitally essential in carrying out this process on a large scale, otherwise chemicals may be applied at a greater strength than is really required, which means not only pecuniary loss, but a retarding influence upon the growth of the fruit and the plants.

It is very desirable that the right type of material be used and at the correct dilution. This latter factor is undoubtedly of paramount importance.

Apparently the various chemicals utilised in these experiments have been applied at too great a concentration, as shown in the cropping records. It will, therefore, be necessary to repeat these experiments next season at a greater dilution.

These dilutions can only be determined after an attempt has been made to classify the soil organisms and to determine their resistance to the chemical treatment. It might then be possible to compare the various concentrations, using carbolic acid as a standard ; the dilutions could then be expressed as a coefficient in

terms of carbolic acid, similar to the Rideal-Walker figure which is used in the case of disinfectants.

The increase in the root fibres, which is shown in the photographs, must, of course, benefit the plant considerably owing to the greater food-absorbing area.

The use of dichlorcresol certainly produces a better colour in the foliage and a sturdier haulm than does the ordinary cresol.

It will be necessary in future experiments to determine to what extent dichlorcresol acts as a stimulant and also whether there is any tendency to force the plant and produce early maturity of the fruit.

The experiments also show the value of the chemicals that have been used in preventing root-canker and eelworm damage. This is very distinctly shown in the photographs.

The experiments also suggest an extended use for p-Toluene sodium sulphochloramide in view of the very great dilution at which this substance can be used. The six-weeks' stationary period of the plants in plot 4 may possibly be explained by the fact that at 0·1 per cent. this substance produces complete sterilisation of the soil, and, in consequence, plants would only be able to make progress after the soil had become reinfected with the necessary organisms from the air, or by watering the plants in the usual manner, or from dust blown from the adjoining plots.

It might be suggested that the increased root fibres in plot 3 were due to the action of the basic slag, but in plot 2, where the mixture of dichlorcresol and cresol was used, the results are practically identical. In plot 5, where the cresol only was used, the results are quite different, which seems to point to the fact that the dichlorcresol is responsible for the increased growth.

T. Parker, A. W. Long and J. S. Mitchell.

Red Spider*

A NOTE ON ITS CONTROL.

THE long spell of hot, dry weather experienced in 1921 was no doubt responsible for the presence of large numbers of "red spider" under glass. In fact, in some cases this pest appeared in almost epidemic proportions.

The author and his collaborators had, in consequence, an excellent opportunity for carrying out a number of experiments for testing the utility of a variety of chemical and physical means for controlling this annoying pest.

The results of these tests are given below. The chemicals used have included combinations of nicotine, liver of sulphur, dichlorcresol, and chloropicrin, in conjunction with petroleum emulsion, applied either as sprays or for dipping.

A number of fumigations have been carried out, utilising carbon-tetrachloride, trichlorethylene, chloropicrin, tetrachlorethane, and pentachlorethane.

The Carnations purchased were "stopped plants," planted in 48's pots at the beginning of May in light sandy soil, which had previously been treated with a solution of emulsified dichlorcresol, containing 45 per cent. of the active principle, the solution being applied at a dilution of one part of the emulsion to 400 parts of water, at the rate of one gallon of the dilute solution to one cubic yard of soil, and then "watered in."

The plants continued to grow favourably until the beginning of June, when the "red spider" was observed to be present. The

* Contributed from the Agricultural Testing Station of Messrs. Murphy & Son, Ltd., and issued by the Technical Committee of the Chamber of Horticulture.

pest was allowed to propagate and to become firmly established until June 20th, when all the plants were sprayed on the dates shown in table, with the materials as indicated.

	Date.	Material used.	Containing	Dil. Sprayed.	Remarks.
1	21.6.21	Nicotine Petroleum Emulsion	2% Nicotine 50% Petroleum Boiling Pt., 150-220°C. 30% Fish Oil Soap	1-80	Owing to waxy bloom on leaves, spray did not adhere, but accumulated at the axils of the leaf. A few spiders killed.
2	12.7.21	50% Arsenate of Lead	15% $AS_2 0_5$	1-500	Used as a precautionary measure against caterpillars which had appeared.
3	19.7.21	Nicotine Petroleum Emulsion	Same as No. 1	1-80	Same as No. 1.
4	21.7.21	Common Salt Solution	1·2%	1-80	Same disadvantage as in No. 1. with very little insecticidal value.

As these spraying experiments seemed to give very little satisfaction, the plants were left without any further treatment until August 19th, 1921, when the 100 pots were divided up into five lots of 20 plants each and labelled Set 1, 2, 3, 4, and 5. No. 5 Set was reserved as a control, and received no further treatment whatever.

The plants in the remaining sets were each dipped in two gallons of the particular fluid under observation for approximately one minute, and allowed to drain in a horizontal position. The solutions tested were as follows:—

Set No.	Solution used for dipping.	Containing	Dilution of dip.
1	Nicotine Petroleum Emulsion	2% Nicotine 50% Petroleum 30% Soap	1-70
2	Chloropicrin Petroleum Emulsion	5% Chloropicrin 45% Petroleum 25% Soap	1-80
3	Liver of Sulphur and Petroleum Emulsion	16% Pot Sulphide 34% Petroleum	1-40
4	Chlorcresol Petroleum Emulsion	10% Dichlorcresol 50% Petroleum 30% Soap	1-70

On August 19th, 1921, the plants were dipped at 11 a.m., as shown above, for approximately one minute, and allowed to drain. They were then replaced in their respective positions in the house, and on August 24th, 1921, the plants were treated as follows :—

Dipped in the various solutions at 9-30 a.m. and 4-30 p.m., with an intermediate syringing with clear water.

On August 25th, 1921, the plants were syringed only with water, and on August 26th, 1921, at 3 p.m., again dipped, as on August 19th, 1921.

Subsequent treatment consisted of daily syringing with clear water for 14 days, followed by the same treatment on alternate days.

Observations on the Dipping Experiments.

1. Nicotine Petroleum Emulsion.

   Produced slight scorching of the leaves, leaving a stain (probably as a result of using " hard " water in the experiments). This wash left the foliage practically clear of spider. " Rust " was observed to be present.

2. Chloropicrin Petroleum Emulsion.

   Caused considerable bleaching of the leaves, the tips of the younger shoots being killed outright. There were a large

number of " spiders " left alive, and a fair amount of "rust" ; in fact, these plants were very little better than those of the control set, No. 5.

3. Liver of Sulphur and Petroleum Emulsion.

   Gave the best results of all, the plants being free from " spider," and no sign of " rust."

4. Chlorocresol Petroleum Emulsion.

   The plants were entirely free from " rust." All new growth appeared quite clean and healthy, much less "spider" was noticed than in the case of No. 1. The plants looked fairly healthy.

5. Control.

   The plants looked very unhealthy indeed, the leaves being covered with a black deposit, resembling dust, probably excretory or cast skins from the " spider."

   The leaves at the base of the plant were entirely killed by the " spider," and a large amount of " rust " present.

Fumigation Experiments.

A large number of fumigations were carried out, using the materials previously mentioned. The method consisted of placing Carnation plants, which were badly infested with " spider," in a chamber of known capacity (300 cubic feet), which could be hermetically sealed, and vapourising the liquid at the concentrations shown.

Substance used.	Time fumigated.	Concentration of fumigant.	Observations.
Carbon Tetrachloride	16 hrs. 40 mins.	10 ozs.— 1,000 cu. ft.	Ineffective in killing the spider.
Trichlorethylene	Ditto	Ditto ...	Ditto
Tetrachlorethane	Ditto	Ditto ...	Ditto
Pentachlorethane	Ditto	Ditto ...	Ditto

In view of the results obtained with the tetra- and pentachlorethane—a further set of fumigations were carried out in the following manner :—

October 6th, 1921, Thursday, 6 p.m.—

Fumigated with 10 ozs. to 1,000 cubic feet.

October 7th, 1921, Friday, 6 a.m.—

Opened up the chamber and allowed fumes to disperse. Doors kept open all day.

October 7th, 1921, Friday, 6 p.m.—

Fumigated again at same concentration.

October 8th, 1921, Saturday, 6 a.m.—

Opened up and allowed to remain open over the week-end until Monday evening.

October 10th, 1921, Monday, 6 p.m.—

Fumigated again at same concentration.

October 11th, 1921, Tuesday, 6 a.m.—

Opened up. Plants exposed to the air for two days, and examined for mortality of "spider."

These results were not much better than those obtained in the single fumigations, only showing a mortality of about 25 per cent.

The experiments were repeated, using the fumigants at double strength.

Fumigant.	Time fumigated.	Temp.	Concentration.	Mortality.
Tetrachlorethane	12 hrs.	50°F.	20 fl. ozs.— 1,000 cu. ft.	Uncertain
Pentachlorethane	12 hrs.	50°F.	20 fl. ozs.— 1,000 cu. ft.	Uncertain

Experiments with Cucumber Plants, using Nicotine Petroleum Emulsion.

The method adopted for spraying Cucumbers was as follows :— The nicotine petroleum emulsion contained 5 per cent. of nicotine sulphate (40 per cent.), 50 per cent. petroleum, and 30 per cent.

soap (potash fish oil), and was first used with a fine " mist " sprayer at a dilution of 1 part to 80 parts of water. This strength of spray fluid produced results somewhat variable in character, especially if used in the vicinity of the sea coast, where scorching occurred to some extent. Yet if used under ordinary inland conditions, no scorching occurred. This detrimental effect may possibly be due to the presence of hydrogen peroxide and salt in sea air, which might cause the de-emulsification of the oil.

As a result of this, it was decided to use the insecticide at a greater dilution, namely, 1 part to 160-200 parts of water, and this dilution, whilst still toxic to the " spider," did not cause any deleterious effects upon the Cucumber plants.

The following procedure carried out on a commercial scale proved quite satisfactory :—

The plants were sprayed with the fluid at 1-160 dilution in the evening, and the following morning were syringed with clear water, this treatment being repeated once or twice. There is no doubt that the " spiders " were unable to survive the repeated sprayings. Although the Cucumber is a very sappy and tender plant, very little scorching occurred.

The author is extremely indebted to Messrs. A. U. Kemsley, of Shoeburyness, for their help and co-operation in the Cucumber experiments.

Summary of Experiments.

1. Spraying for " red spider " on Carnations is very unsatisfactory, owing to the waxy bloom, which causes the spray fluid to collect in globules at the axils of the leaf.

2. Dipping produces much better results, but this method can only be applied to potted plants when not in bloom, and must be repeated once or twice.

3. Liver of sulphur and petroleum emulsion gives the best results in the dipping experiments in killing the spider without damaging the plants. There is, however, the disadvantage of foliage staining, due to the depositions from the dipping solutions.

4. Liver of sulphur and chlorocresols are quite effective in controlling Carnation "rust."

5. Fumigating with either the tetra- or penta-chlorethane at the rate of 10 or 20 fluid ozs. to 1,000 cubic feet for 12 hours, produces uncertain results without any deleterious effect upon the Carnations.

6. Nicotine petroleum emulsion, containing 2 per cent. nicotine and 50 per cent. petroleum oils, is quite effective in controlling the "red spider" on Cucumbers, provided that the "sprayings" are carried out at the dilutions suggested and in the manner prescribed.

In conclusion the author wishes to thank Messrs. A. W. Long and J. S. Mitchell for their valuable help in carrying out the experimental and cultural work.

THEODORE PARKER.

Notes and Comments

A Bulb Pest.

GROWERS of bulbs in water culture, peat moss, or fibre, for indoor decoration are frequently disappointed at the non-appearance of the flowers. After purchasing expensive bulbs of choice varieties of Hyacinth, Narcissus, etc., and perhaps after weeks of watching in vain for signs of the beautiful blooms that the vendor declared, in all good faith, would materialise, they are finally thrown out in disgust. If trouble be taken to look inside the bulb for the explanation it will, as often as not, be found that the flowering scape has been eaten away and is replaced by a black disagreeable-looking substance. This is the work of the Bulb Mite, *Rhizoglyphus echinopus* Fum. and Robin, so small, individually, as to require a lens for its detection. The accompanying photograph Fig. 5, shows a typical example of the destruction due to this mite. It will be seen that the scape, or flower stalk, (*a*), has been eaten off squarely, the space above being occupied by an accumulation of black decaying matter and excreta, (*b*). On opening it was found to contain hundreds of mites in all stages of development. Attacks by this mite are usually of a secondary nature and follow upon disease due to Eel-worms or Bulb Flies, but not infrequently the mite is alone responsible. In this instance the mite was the primary and only cause of the bulb not flowering. The bulb was in an active growing condition and the mites appear to have concentrated on the growing point, as is well shown. The dark band seen at (*c*) is due to secondary fungus growth from spores transported from the outer scales, (*d*), by the mites.

This pest can be destroyed without injury to the flower if its destruction and, indeed, prevention is taken in hand at the right

time. Immediately after purchase and before the bulb is put under culture it should be treated with a solution of Nicotine Petroleum Emulsion. A solution containing this Emulsion at the rate of 1 oz. to 1 gallon of water is sufficiently strong for the purpose. The bulbs, before potting or placing in vases, should be immersed in this solution for one minute and then allowed to drain. The solution should not be allowed to drain into the water used in the vases for bulbs in water culture. As a further precaution the bulbs should be sprayed with the same mixture at two or three intervals between potting and flowering.

FIG. 5.

Schizophyllum commune Fr.

An Interesting Fungus.

SOME illustrated notes on this agaric (a fungus of the toadstool type, but without a stem), by Mr. F. A. Mason, writing from the Bureau to *Nature*, March 2nd, 1922, will be expanded here. *S. commune* is of special interest to students of the fungi, as it is the only European representative of a genus characterised by split gills. This feature is well illustrated in Fig. 9.

S. commune possesses the property of responding to conditions that tend to produce desiccation to a degree unique among the fungi, and is thereby well adapted for a xerophytic existence. That behaviour in a plant that results in an alteration of form, or position of parts, for protection against the dangers of desiccation, is known as *xerotropism*. The result of xerotropic action in the case of this fungus is seen in the photograph reproduced in Fig. 6.

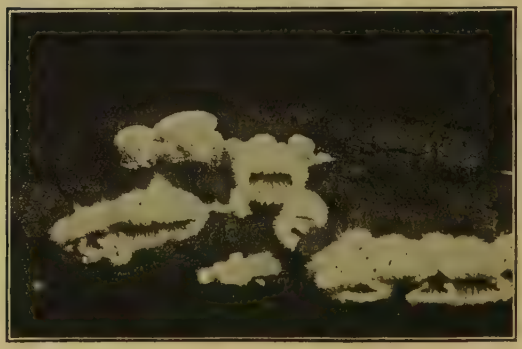


Fig. 6.

To all appearances the fungus is dead ; many species presenting a similar appearance on trees, old logs, etc., certainly would be dead. If the appearance presented by the specimens illustrated is only a temporary one, assumed for resistance of drought conditions, as has been shown to be the case by Prof. Buller, then one would expect a reversion to the normal form when the fungi are placed in favourable surroundings with regard to moisture and temperature. A piece of bark, bearing specimens shrivelled similarly to those shown in Fig. 6, was saturated with moisture and placed in a moist chamber. At the end of two hours the fungi had revived and presented the appearance seen in Fig. 7. Within a few hours spore dissemination recommenced, and continued throughout the following week.

As mentioned above, the genus Schizophyllum is characterised by gills that are longitudinally split along the edge. It differs so much from its nearest allies among the agarics, as to constitute,

Fig. 7.

in itself, one of the Sub-Orders (*Schizophyllæ*) recognised by Engler and Gilg in their classification of the Agaricaceæ. In descriptions of *S. commune*, the edges of the split portion of the gills are stated to be " incurved," " revolute," etc. Massee, British Fungus Flora, Vol. II., p. 30, says : " Lamellæ composed of two rather remote plates united at the back and with their sides involute." Attention may be drawn to the fact that in the mature, *fully expanded* fungus containing the optimum proportion of moisture, the lamellæ are closely adherent, and their lamellation is not superficially evident. This is well indicated by some of the sporophores in the photograph, Fig. 8. Thus, the gills of *S. commune* exhibit *geotropism*, that is, they become vertical to the force of gravity for spore dissemination to the same degree as other gill-fungi, which would not be anticipated from the description. In the opinion of the writer it would be a more accurate description of the lamellæ to say " with their sides becoming involute."

It has been remarked, but not further emphasised by Prof. Buller, that the pileus of *S. commune* is of an absorbent nature. Indeed, the pileus shows a remarkable avidity for water, and the hairs composing the woolly covering of the pileus enable it to absorb moisture with a greater rapidity than is usual in fungi, so far as the writer is aware. The moist condition of the edge of the pileus remote from the matrix, immediately after wetting the latter, and rendered evident by the transition from snow-white to a silvery-grey colour, led to several experiments. It was found that the application of a drop of water to one edge of a dry pileus resulted in an immediate, and apparently uniform, diffusion of moisture throughout the woolly covering of the whole pileus—about 1·5 cm. diameter. The rate of absorption is much greater than that seen in the absorption of ink by blotting paper, and this fact was more convincingly demonstrated by the use of a dilute aqueous solution of methylene-blue.

It seems reasonable to suppose that the possession of this property will enable the fungus, in its xerotropic condition, to take the fullest advantage of any raindrop that may fall upon it

by instantly absorbing it. This supposition was tested by allowing drops similar in size to tropical raindrops to fall from a height on to the pileus, and it was observed that each drop was immediately absorbed, without splash, until saturation point was reached. Were its absorbent power less, much water would be lost to the fungus on account of its sharply convex outline.

Conservation of water, in the case of a group, is assured by the imbricate habit of *S. commune*. The pileus of a plant growing at the top of a group of sporophores collects all the raindrops that reach it until it becomes saturated, after which the surplus drips on to the pileus of a plant below, and so on, until a whole group has obtained its full requirements without the loss of a single drop.

The moisture content of the fully expanded fungus and of the xerotropic form respectively are given below. They are the results of one determination only in each case. The specimens were dried in a water oven at 99°–100°C. for five hours, with all the precautions usually taken in the estimation of moisture.

Normal sporophore	water = 84·3 per cent.
Xerotropic form	water = 16·0 per cent.

The specimens used in these experiments were collected at the Worcester Foray of the British Mycological Society, and became available through the courtesy of Mr. W. N. Cheesman, of Selby.

Trogoderma khapra

With reference to the Memorandum of the Ministry of Agriculture, printed on p. 132, and our former notes on this insect grain pest, we have now received specimens taken from a sack of malt in a brewery in Cornwall. These were sent to us by Mr. G. W. Smallwood, whose interest in the technical aspects of his business are well known to brewers.

F. A. M.

Fig. 8.

Fig. 9.

Fig 10.

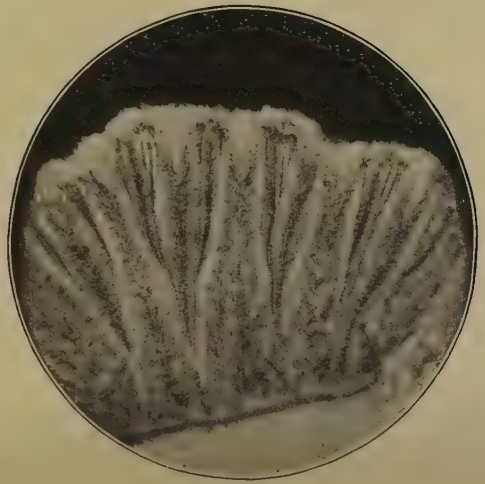


Fig. 11

The "BIOTEC" Series of Lantern Slides.

A series of lantern slides for the use of teachers and lecturers in General Botany, Fungi, Applied Mycology, Micro-biology, Economic Entomology, etc., is in preparation and will be issued by the Bureau, lists of which will be published in the *Bulletin*. The first set illustrates *Schizophyllum commune* Fr., and comprises six photographs from nature as reproduced in Figs. 6—11.

No. 1.—	*S. commune.*	Xerotropic form.
,, 2.—	Do.	Normal form, revived from 1.
,, 3.—	Do.	Gills; lamellæ adherent, illustrating geotropism.
,, 4.—	Do.	Gills; lamellæ separating due to loss of moisture.
,, 5.—	Do.	Advanced xerotropism—folding of the gills and inward curl of pileus.
,, 6.—	Do.	Photo-micrograph illustrating underside of gills folded back to protect hymenium, and hairs with which the lamellæ and inter-gill-spaces are clothed.

The price, for single slides in the "Biotec" series, is 6/- per slide. The set of 6 slides will be supplied at 30/- nett, and may be obtained from Murphy & Son, Ltd., The Cedars Laboratories, Sheen Lane, London, S.W. 14. All Teachers of Botany should possess a set of these slides on account of their unique interest, and for their application to the study of the Fungi for class purposes.

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ESTABLISHED 1880

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